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ABSTRACT

This guide presents information on controlling insect pests of ornamental trees and shrubs. It is organized for easy reference by nurserymen, arborists, and others desirous of controlling insect damage. General information given includes notes on spraying and sprayers, insecticides, general purpose sprays, phytotoxicity, and health precautions. Common insect pests of ornamentals are described and control methods suggested. There is a listing of ornamentals common to the Indiana, Illinois, Kentucky, and Ohio area, along with their most frequent insect pests. A spray schedule is given and a dilution and conversion table included. (HM)

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Insect Pests of Shade Trees and Shrubs

a guide for commercial nurserymen and arborists

by

Donald L. Schuder
Department of Entomology

This publication is a guide for nurserymen, arborists and others interested in controlling insect pests of ornamental trees and shrubs. The hosts are listed alphabetically for easy reference. No attempt is made to list all the insects that attack any particular host, but only the common ones that are apt to cause serious concern. The Department of Entomology at Purdue University will be glad to identify and suggest control measures for insects not listed. Send samples of the insect and injury, if possible. Place the insects in a small bottle and infested plant materials in a plastic bag for shipping.

SE 024 284

TABLE OF CONTENTS

	Page
Notes on Spraying	2
Sprayers	2
Insecticides	3
General Purpose Sprays	3
Phytotoxicity	3
Health Precautions	4
Description and Control of Common Insect Pests of Ornamentals	6
List of Ornamentals and Their Insect Enemies	12
Spray Schedule for Insect Pests of Ornamentals	33
Dilution and Conversion Table	37

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NOTES ON SPRAYING

It is difficult to predict when many of the insects that affect trees and shrubs will appear in destructive numbers. Other insects like scales, mites and leaf-feeding caterpillars are present nearly every season and require regular control measures. The nurseryman or arborist should keep spraying equipment in working order and have a supply of the more common chemicals on hand for immediate use. When infestations appear, apply the insecticide which lists the insect on its label.

You may need to add a wetting agent to the spray mixture for plants that are difficult to wet with sprays. Santomerse S, B-1956 (Triton), and Plyac and DuPont Spreader-sticker are satisfactory. Common household laundry detergents may also be used. If you want less foaming action, try a low-suds detergent.

Do not apply dormant oil sprays when the temperature is below 45° or when freezing temperatures might occur before the spray has dried.

To minimize the chances of plant injury, it is a good idea not to spray when temperatures are over 85°F. Apply pesticides during the morning so that the leaves will be dry before the hot afternoon temperatures prevail.

SPRAYERS

The types and sizes of sprayers on the market range from the simple 1- to 3-gallon compressed air sprayer to the large, high-pressure power rigs. The kind needed varies with size of the plantings to be protected.

A power sprayer should have a minimum capacity of 10 to 25 gallons per minute and should develop a pressure of approximately 125 to 200 pounds per square inch or in the case of a mist blower, an air velocity of 10,000 cubic feet per minute. These minimums are essential to cover all surfaces

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thoroughly. You will not be able to penetrate dense foliage or reach the tops of tall trees with lower pressures.

An agitator, a long hose and non-corrosive parts are desirable components of a good sprayer. Buy your sprayers from reliable companies who will be able to supply parts whenever needed.

INSECTICIDES

Local hardware, drug and garden supply stores usually carry the common insecticides. Farm and orchard supply dealers often have, or can obtain, new spray materials that are not widely distributed.

For a list and description of available insecticides, obtain a copy of Purdue Extension Publication E-54, Dictionary of Insecticides and Related Chemicals, from your County Extension office, or write to Agricultural Publications, AGAD Building, Purdue University, West Lafayette, Indiana 47907.

GENERAL PURPOSE SPRAYS

Frequently, a general purpose spray is used on ornamentals. Suggested materials and dilutions are listed in Table 1. These materials may be combined into one spray or used separately.

General purpose insecticide and fungicide dusts are not generally suited for treating large shrubs and ornamental trees.

Table 1. Suggested materials for ornamentals.

Toxicant and formulation	Amt. / 100 gal.	Amt. / 1 gal.
malathion 57% EC*	1 qt.	2 tsp.
Kelthane 18% WP*	2 lbs.	2 tsp.
captan 50% WP	2 lbs.	2 tsp.

* EC = emulsifiable concentrate; WP = wettable powder; tsp. = teaspoonful.

PHYTOTOXICITY

Certain insecticides will injure certain plants. These are listed as follows:

Benzene hexachloride (BHC) can injure apple and birch trees when they are oversprayed.

Carbaryl (Sevin) injures Boston ivy, Boston fern, Schefflera and Virginia creeper.

Chlorbenzilate may damage hydrangeas; its effectiveness on roses dusted with sulfur is reduced.

Demeton (Systox) will defoliate Bechtel's double flowering crab apple.

Diazinon injures begonias, ferns, hibiscus, gardenias, stephanotis and African violets.

Dimethoate (Cygon) causes defoliation of honey locust and elm. Also, dimethoate should not be used on flowering almond, dahlias, plum, peach, cherry, chrysanthemums, Chinese holly, hibiscus, hollies or scheffleras.

Ethion should not be applied to yews or redbud.

Lead arsenate injures and may defoliate Vibernum carlesi, forsythia and flowering peach.

Malathion severely injures Cannaert, Sargeant's and Burk junipers, Ilex rotunda, Boston and maiden hair ferns, crassula, violets, African violets, petunias, gloxinias, red carnations, pepperplants, and the rose varieties Caledonia and Talisman. In southern areas, injury has been reported on Podocarpus nagi, Philodendron friedrichstahli, Pilea cadierei, Tibouchina, Feijoa sellowiana, Cocculus laurifolia, Ficus carica, Cassia bicapsularis, hibiscus and Euphorbia pulcherrina var. alba. Meta-Systox R has

caused injury on begonias, ferns, coleus, hollies and scheffleras.

Oil-sensitive plants include beech, black walnut, butternut, hickory, cryptomeria, mountain ash, Japanese maple, red maple, sugar maple, yellowwood, Russian olive, Norway spruce, yews, hemlock, magnolias, redbud, boxwood and other broad-leaved evergreens and junipers. (Oil-tolerant plants are apple, box elder, elm, flowering dogwood, linden, rose, burr oak, pin oak, post oak, and white oak.)

Ovex (Ovotran), a miticide, is toxic to azaleas, beech, boxwood, barberry, deutzia, dogwood, Ilex glabra, I. crenata, I. bullata, I. cornuta, and I. opaca, raspberry, oak, hawthorn, spruce, sycamore, and Katsura tree.

Parathion can noticeably injure asters, gladiolus, grapes, ferns, forsythia, goldenrain tree, African violets, Ilex rotunda, and rhododendrons. In southern areas, papaya, Podocarpus nagi, poinsettias, Pilea cadierei, Tibouchina, gardenia, Hibiscus rosasinensis and Ficus carica have been injured. Combined with sulphur, parathion can defoliate roses.

Phorate (Thimet) distorts new growth of Eleyi crab apple trees.

Phosphamidon causes defoliation of thornless honey locust trees.

Sulfur is toxic to viburnums, forsythia and peaches.

Tedion (tetradifon) may injure some varieties of roses and scheffleras.

Thiodan (endosulfon) may injure birch and geraniums.

Toxaphene will injure linden, oak, sugar maple, imperial gage plum, grape, peach and pear trees.

Zectron should not be used on scheffleras or ferns.

HEALTH PRECAUTIONS

The organic insecticides are toxic to many kinds of insects. But many are also toxic to humans. When handling and applying organic insecticides, carefully follow the manufacturer's suggestions and precautions and use common sense at all times. Avoid spilling insecticides on the skin, or breathing the fumes or dusts when filling the sprayer.

Many of the organic phosphates, such as parathion, are the most poisonous insecticides now in use. Deaths have resulted when precautions were not heeded. HOME GARDENERS AND SPRAY APPLICATORS WHO HAVE NOT BEEN TRAINED SHOULD NOT USE THOSE ORGANIC PHOSPHATES THAT ARE HIGHLY POISONOUS. Always read and follow the directions on the label. When handling parathion or closely-related materials, avoid careless spilling or spattering. Always wear natural, not synthetic, rubber gloves and a mask. Suitable masks, like the Agrisol Chemical Cartridge Respirator, are available from E. A. Kinsey Co., Inc., 1550 Stadium Dr., Farm Bureau Co-op, 47 S. Pennsylvania St.; or Cory Orchard Supply Co., 425 S. Senate Ave., all in Indianapolis, Indiana.

In case of illness from exposure to parathion, see a doctor immediately. Atropine is an antidote for parathion poisoning and should be administered as soon as possible.

Many physicians are not prepared to handle insecticide poisoning cases. Therefore, Poison Control Centers have been established around the state. These centers are equipped to either treat individual cases of supply information to physicians. Indiana Poison Control Centers are listed on page 5. Pass this information on to your physician so he will have a source of information in case you are accidentally poisoned.

Poison Control Centers

City	Name and Address	Telephone	Director and Assistant Director
	INDIANA		
Anderson	St. John's Hospital 2015 Jackson Street 46014	(317) 646-8365	T. J. Schroeder, Department Director of Pharmacy
Angola	Cameron Memorial Community Hospital 416 East Maumee Street 46703	(219) 665-3151	C. Pool, R.N. J. Nier, R.N.
Crown Point	St. Anthony Medical Center Main at Franciscan Road 46307	(219) 738-2100 663-8120	Dr. S. Price, Medical Director Miss T. Matusik, Nursing Coord.; ER-OP
East Chicago	St. Catherine Hospital 4321 Fir Street 46312	(219) 392-7203	H. Levin, M.D., E.R. Dir. Zallen, M.D. Dir. of Poison Control
Elkhart	Elkhart General Hospital Emergency Room 600 East Boulevard 46514	(219) 294-2621	C. Richard Yoder, M.D.
Evansville	Deaconess Hospital Emergency Room 600 Mary Street 47710	(812) 426-3405	Miss M. Wallace, R.N.
	St. Mary's Hospital 3700 Washington Avenue 47715	(812) 479-4491	Julian D. Present, M.D.
	Welborn Memorial Baptist Hospital 401 Southeast Sixth Street 47713	(812) 426-8336	Richard F. Emig, R.Ph., Chief Pharmacist
Fort Wayne	Parkview Memorial Hospital 2200 Randalia Drive 46805	(219) 484-6636 Ext. 7800	Wm. O. Wissman, Director
	St. Joseph's Hospital 700 Broadway 46802	(219) 423-2614 Ext. 2211	Jon Wolf, Pharmacist
Frankfort	Clinton County Hospital 1300 South Jackson Street 46041	(317) 654-4451	William J. Russell, Hospital Administrator
Gary	Methodist Hospital of Gary, Inc. 600 Grant Street 46402	(219) 886-4710	Mrs. Elnora Sharp, R.N., Director of Emergency Service
Goshen	Goshen General Hospital Emergency Department 200 High Park Avenue 46526	(219) 533-2141 Ext. 394	Mrs. K. Summerville, Nursing Supervisor Mrs. S. Risser, PCC-ER
Hammond	St. Margaret Hospital 25 Douglas Street 46320	(219) 932-2300	Dr. D. L. July, Pharmacy Director—Clinical Pharmacist
Huntington	Huntington Memorial Hospital 1215 Etna Avenue 46750	(317) 356-3000	T. L. Messler, R.Ph.
Indianapolis	Methodist Hospital of Indiana 1604 North Capitol Avenue 46202	(317) 927-3033	Maxine J. Bush, R.N.
	*Wishard Memorial Hospital 1001 West Tenth Street 46202	(317) 630-7531	Carolyn Cunningham, M.D., Project Director
Kokomo	Howard Community Hospital 3500 South LaFountain Street 46901	(317) 453-8444	George R. Banyak, Hospital Administrator
Lafayette	St. Elizabeth Hospital Medical Center 1501 Hartford Street 47904	(317) 742-0221	W. L. Knochel, M.D., Coordinator Lois Thoennes, R.N., Director of Emergency Out-Patient Services
LaGrange	LaGrange County Hospital W. Michigan Street 46761	(219) 463-2144	Merle V. Rawson, R.Ph., Director
LaPorte	LaPorte Hospital 1007 Lincolnway 46350	(219) 362-7541 362-3585	Mrs. Veronica Doig, Head Nurse
Lebanon	Witham Memorial Hospital 1124 North Lebanon Street 46052	(317) 482-2700	Berniece Martz, R.N., Director of Nurses Pat Isenhower, R.N., Education Director

* Principal information center for the State of Indiana. (Formerly Marion County General Hospital, 960 Locke Street.)

Poison Control Centers

City	Name and Address	Telephone	Director and Assistant Director
	INDIANA		
Madison	King's Daughter's Hospital 47250	(812) 265-5211	W. A. McAlexander
Marion	Marion General Hospital Emergency Room Wabash and Euclid Avenue 46952	(317) 662-4694	John Kennedy, M.D.
Merrillville	Broadway Methodist Hospital 8701 Broadway 46401	(219) 738-5510	R. B. Glesne, Hospital Administrator
Mishawaka	St. Joseph Hospital 215 West Fourth Street 46544	(219) 259-2431 Ext. 233 or 234	Mrs. C. Yoder, R.N., Staff-Nurse of Emergency Room
Muncie	Ball Memorial Hospital 2401 University Avenue 47303	(317) 747-3241	Mrs. J. Hardy, R.N., Head Nurse of Emergency Room
Portland	Jay County Hospital 505 West Arch Street 47371	(219) 726-7131	Janet Barrett, R.N., Director of Nursing
Richmond	Reid Memorial Hospital 1401 Chester Boulevard 47374	(317) 962-4545	Jewell Spears, R.N.
Shelbyville	William S. Major Hospital 150 West Washington Street 46176	(317) 392-3211 392-3793	Lolah Brooks, R.N., Head Nurse Jayne Emerick, R.N., Emergency Department Supervisor
South Bend	St. Joseph's Hospital 811 East Madison Street 46634	(219) 237-7253	David Anderson, Assistant Administrator
Terre Haute	Union Hospital, Inc. 1606 North Seventh Street 47804	(812) 232-0361 Ext. 397	Darrell Propst, Chief Pharmacist
Vincennes	Good Samaritan Hospital 520 South Seventh Street 47591	(812) 885-3348	Donald M. Friedmann, Director of Pharmacy Service Randall K. Dreiman, Assistant Director of Pharmacy Service
Coordinator for Indiana	*Poison Control Coordinator for Indiana Indiana State Board of Health Hazardous Products Section Division of Drug Control 1330 West Michigan St. 46206	(317) 633-4830	Carl Huber, Public Health Sanitarian Robert J. Murray, State Health Commissioner
	ILLINOIS		
Danville	St. Elizabeth Hospital 600 Sager Avenue 61832	(217) 442-6348	Dr. Suzuki, M.D.
Hoopeston	Community Memorial Hospital 701 East Orange Street 60942	(217) 283-5531	T. S. Strzembosz, M.D.
Mount Carmel	Wabash General Hospital 1418 Maysville Road 62863	(618) 262-4121	T. R. Young, M.D.
	KENTUCKY		
Louisville	Norton Children's Hospital 200 East Chestnut Street 40202	(502) 589-8222	Mary A. Smith, M.D.
Owensboro	Owensboro-Daviess County Hospital 811 Hospital Court 42301	(502) 683-3511 Ext. 275 (day) Ext. 232 (night)	Bill McKnight
	OHIO		
Cincinnati	Poison and Drug Information Center 234 Goodman Street 45267	(513) 872-5111	Leonard Sigell, Ph.D. Jennifer Loggie, M.D., Executive Medical Officer

* Available for information on the functions of all area poison information and treatment centers.

Description and Control of Insect Pests of Ornamentals

Common insects attacking ornamental trees and shrubs are divided here according to the manner in which they feed and the damage they cause -- sucking insects, leaf feeding or chewing insects, borers or boring insects, leafminers, gall producing insects and mites.

SUCKING INSECTS

This group includes the various aphids, lacebugs, plant bugs and leafhoppers that weaken plants by sucking out the plant sap. These insects frequently inject secretions into the plant tissue which injure or kill plant cells.

Aphids or Plant Lice

These are small, soft-bodied insects that may vary from green to shades of red, brown or black. They may attack the plant both above and below the ground, but commonly cluster on new growth or on the underside of leaves. When aphid populations are heavy, they may cause twigs and leaves to curl and twist, flower buds to harden, and flowers to become malformed. Aphids secrete a sweet, sticky substance called "honey-dew." This material attracts ants and flies and is a nuisance on cars, chairs, tables, etc. that happen to be under infested plants. A black, sooty mold may grow on the honey-dew, thus making plants unsightly.

Control: Aphids are best controlled during the summer. Apply per 100 gals. of water, one of the following: 1 pt. of 40% nicotine sulfate plus 4 lbs. of soap, or 1 lb. of 25% lindane WP, or 1 1/2 pts. of 20% lindane EC, or 1 to 2 pts. of 57% malathion EC, or 1 qt. of thiodan (2 lbs. per gal. EC) or 1 to 2 qts. of 25% diazinon EC.

The poisonous insecticides parathion and tetraethyl pyrophosphate (TEPP) are very effective against aphids, but are not recommended for use by anyone unfamiliar with handling dangerous poisons. Lindane or benzene hexachloride are best for wooly aphids. Several systemic insecticides, such as dimethoate (Cygon), and Di-Syston are also effective aphicides. Use only according to directions.

A forceful stream of water will help remove the sticky honey-dew from plants. Since ants frequently transport aphids, kill the ant colony by treating the nesting areas with chlordane (see Purdue Extension Publication E-22, How to Control Ants). Aphids that overwinter on the host can be controlled by using the same dormant sprays suggested for Scale Insects (see page 7).

Lacebugs

These insects are about 1/8 inch long and are dark with transparent, lacy wings. Both adults and nymphs feed on the underside of leaves. They extract so much plant juice that leaves become pale and mottled with white splotches. The lower surface of leaves are spotted with black and brownish dots.

Control: Starting about the last of May, apply 1 lb. of 25% lindane WP, or 1 to 2 pts. of 57% malathion EC, or 1 qt. dimethoate (Cygon) EC, or 1 pt. 40% nicotine sulfate per 100 gal. of water. The systemic insecticide disulfoton (Di-Syston) is effective. Parathion is also highly effective, but is not recommended for untrained spray applicators. Be sure to treat the underneath sides of leaves.

Leafhoppers

Leafhoppers are small wedge-shaped, active insects that run, hop or fly when disturbed. These sucking insects are usually yellow or greenish, while a few kinds are striped. Leafhoppers feed on the underside

of leaves causing them to become light in color and marked with small white dots on the upper surface. Often the cast skins of the nymphs remain attached to the lower surface of a leaf. Presence of these skins help identify the cause of injury. Some species of leafhoppers are known to transmit tree diseases such as phloem necrosis of elm.

Control: Apply 1 or 2 pts. of 57% malathion EC, or 1 to 2 qts. Diazinon 2 EC, or 2 lbs. of 50% carbaryl (Sevin) WP, or 1 to 1 1/2 pts. Meta-Systox R SC per 100 gal. of water about mid-June, or whenever the insects are discovered. Be sure to direct the spray to the underside of the foliage.

Plant Bugs

These small, shield-shaped insects are active and run or fly freely when disturbed. Both adults and nymphs have sucking mouthparts. Several species inject toxins causing plant parts to wither and die. Terminal buds, shoots and blossoms are commonly affected.

Control: Apply materials mentioned for leafhoppers above, or 1 1/2 pts. 57% malathion EC, or 1 qt. 2 EC dimethoate (Cygon), or 20 to 30 oz. Dylox 80% SP per 100 gal. of water. Spray early in the morning when the insects are least active. Removing weeds, trash and debris is an effective preventive measure.

Scale Insects

Scale insects are inactive most of their lives. They are quite small and usually dark so they are hard to find. Infested plants appear unhealthy, grow poorly, and the foliage may be small and chlorotic. For ease in identifying, scale insects may be broken down into three groups -- (1) armored scales, (2) soft or unarmored scales, and (3) mealybugs.

Armored scales are the most common found on trees and shrubs. They secrete a hard, waxy covering over their bodies and may be circular, oblong or pear-shaped. Armored scales vary from 1/12 to 1/8 inch in length or diameter. Soft, unarmored or lecanium scales have their waxy secretion as an integral part of their body. These scales may be flattened, slightly convex or hemispherical and vary from 1/12 to 1/2 inch long. The nymphs of some soft species feed on leaves during the summer and move back to twigs in the fall. Most species produce honey-dew. Mealybugs are soft-bodied and usually covered with a powdery, cottony-wax material. They vary from about 1/5 to 1/3 inch long when full-grown. Unlike the other kinds of scale insects, the mealybugs can move about throughout their entire life cycle.

Control: Control is often difficult because of inadequate spray coverage. To be effective, spray material must come in contact with the insects. Take care to see that the spray is evenly applied to all parts of the plant. Adding a wetting agent to the spray mix will help wet the insect and insure penetration through its protective covering.

Scale insects may be controlled both during the dormant period and the growing season. During the dormant period, apply 2 qts. of DN (Dinitro) liquid, or 2 lbs. of DN WP, or 11 gal. of liquid lime sulfur, or 3 to 4 gal. of dormant oil emulsion, or 2 gal. ethion plus oil per 100 gal. of water. On oil-susceptible plant species, use superior oil or summer oils. Do not apply dormant oil sprays when the temperature is below 45° or after bud break, or when the temperature exceeds 65°. DN and liquid lime sulfur will discolor paint and stone, so should be used with caution around home plantings.

Summer crawler sprays should be timed to coincide with egg-hatch. Spray for Putnam

scale, pit-making scale of sweet gum, scurfy scale and the gray race of oystershell scale in early June. For brown race of oystershell scale, pine needle scale and juniper scale, spray in early June and again in late July. And, for San Jose scale, euonymous scale and tea scale, spray at monthly intervals. The most commonly available and effective for summer application is 57% malathion EC used at the rate of 1 to 2 qts., or Diazinon (Spectracide) 25%, or 1 1/2 to 4 pts. Guthion 2S or 2L, or 2 pts. Meta-Systox R SC per 100 gal. of water. Repeat in 10 days.

Spray for Terrapin scale, hickory lecanium, cottony maple scale, European elm scale, European fruit lecanium, and spruce bud scale in June; Fletcher's or taxus lecanium and spruce bud scale in mid-July; and tulip tree scale, magnolia scale and oak kermes in mid-August. Besides malathion, carbaryl (Sevin) has been found very effective against lecanium scales. Use 50% Sevin WP at the rate of 2 lbs. per 100 gal. of water. Mealybugs attacking ornamentals (grape or taxus mealybug and juniper mealybug) can be controlled with the same materials used for armored and lecanium scales.

Parathion is highly effective but should be used only by commercial spray applicators familiar with its toxic properties. Other insecticides shown effective against scale crawlers are Ethion, carbophenothion (Trithion), Guthion, demeton (Systox), Diazinon, disulfoton (Di-Syston), and dimethoate (Cygon). For more complete information, see Purdue Extension Publication E-29, Scale Insects on Shade Trees and Shrubs.

LEAF FEEDING, OR CHEWING INSECTS

This group of insects eats solid foliage tissue. They may skeletonize the foliage or entirely defoliate the plant.

Bagworm

The bagworm is a general feeder that may attack the foliage of both deciduous and evergreen trees and shrubs. The bagworm is so named because the caterpillar spends its life inside a silken, spindle-shaped bag. The bags are usually adorned with bits of twigs and leaves from the host plant and usually go unnoticed until extensive damage has been done. The bagworm overwinters in the egg stage inside the old bag. The eggs hatch in late May and early June. The young caterpillars immediately spin bag and continue to enlarge them as they grow. When the larvae mature in late August and early September, the bags are about 2 inches long. There is only one generation each year.

Control: If only a few small trees have bagworms, control by picking off the bags and burning them during the fall and winter or early spring. Spraying is the most effective measure when infested trees are large or numerous. Spray in early June, as soon as possible after the eggs hatch. Small caterpillars are easier to kill. Several insecticides are effective. Malathion EC at the rate of 1 to 2 qts. per 100 gal. of water is the most widely used. Other effective materials are Diazinon, Dylox, toxaphene, Trithion and lead arsenate. Professional spraymen can use 1 pt. Dursban 2E per 100 gal. of water. For complete information, see Purdue Extension Publication E-27, How to Control Bagworms.

Blister Beetles

These are active, black, gray or striped insects that appear suddenly in great numbers during the summer and strip foliage from some species of ornamental trees and vines. These long, cylindrical beetles have an unusual appearance because of their long legs. They are difficult to control.

Control: Apply sprays or dusts of carbaryl (Sevin) to the soil beneath the trees or vines. The insects are killed when they return to the soil in the evening.

Leaf-feeding Caterpillars

Caterpillars vary greatly in size and color. Some may be covered with hairs and spines, while others are entirely naked. They may feed singly or in large colonies. All species eat large quantities of foliage.

Control: Most species are easily controlled with Malathion, Sevin, Ethion, Dylox and Diazinon sprays. The bacterial preparations Dipel, Thuricide and Biotrol are worthy of trial. With some of the webworms, it is essential to use high pressure so that the foliage inside of the web is covered.

Leaf Beetles

These are hard-shelled beetles of many sizes and colors that feed upon foliage of shade trees and shrubs. They may eat holes in the leaves, like the flea beetles, or they may devour the foliage completely, like the willow-poplar leaf beetle.

Control: Spray when leaves are 3/4 expanded or whenever the insects are found. Use 2 lbs. 50% methoxychlor WP, or 2 lbs. 50% carbaryl (Sevin) WP per 100 gal. of water. Lead arsenate at the rate of 4 lbs. per 100 gal. of water plus 1 pt. of summer oil is also effective.

Leaf-rollers and Leaf-tyers

These are caterpillars that feed in concealment they provide for themselves by rolling, folding or tying leaves together. The mature caterpillars are greenish-yellow and about 3/4 inch long.

Control: Apply insecticide before the larvae complete their shelters in early spring and late July. The most commonly recommended insecticide is 1 pt. Diazinon AG 500 EC per 100 gal. of water.

Sawflies and Slugs

These caterpillar-like larvae attack in colonies and strip plants of their foliage. The larvae have five pairs of prolegs, and the adults have transparent wings and a saw-like ovipositor. Some species are called slugs because they resemble small, naked snails. Slugs skeletonize the foliage by eating off the lower surface of the leaf.

Control: Spray with malathion using 1 qt. of 57% EC (1 tbsp. per gal.), or 2 lbs. of carbaryl (Sevin) 50% WP, or 1 lb. Diazinon 50 W, or 1 pt. Diazinon AG 500, or 1 qt. Meta-Systox R, a systemic, per 100 gal. of water. For large acreages apply malathion ULV formulation. Use 10 fl. oz. per acre. Special nozzles are required. Material should be applied in early May before larvae are 1/2 inch in length.

BORERS AND BORING INSECTS

The larval stage of some beetles and moths are called borers. Some of these insects work in the terminal shoots; others work beneath the bark, frequently girdling and killing the tree; still others tunnel in the heartwood, making a tree subject to rot and wind damage. A few species attack healthy trees, but most attack trees and shrubs already weakened or injured by transplant shock, drought, flooding, dirt-fill over the roots, etc. Presence of borer is not evident until it is too late to save the tree; therefore, prevention is most important. The beetles which act as borers are classified into these groups:

Flat-headed borers are sun-loving metallic-colored beetles. The larvae work in the cambium region. Examples are the flat-headed apple tree borer, which attacks many shade and ornamental trees, the bronze birch borer, and Agrilus difficilis Gory, which attacks honey locust trees.

Round-headed borers are long-horned beetles that are abundant and widely distributed. The larvae bore into solid wood. The more important members are the round-headed apple tree borer, hickory borer, locust borer and poplar borer.

Bark beetles or shot-hole borers are small and burrow into the cambium region of weakened trees both as adults and larvae. They are the most destructive group of insects attacking forest trees. They also attack fruits and ornamentals. Examples are the European and native elm bark beetles, which transmit Dutch elm disease, shot-hole borers, hickory bark beetles and ambrosia beetles.

The larvae of some common moths also infest the trunk and larger branches of trees. Common examples are the carpenter worm, leopard moth, peach tree borer and dogwood borer. See instructions under specific hosts in list on pages 12-33.

Borer Prevention: Newly-transplanted trees should be root-pruned in the nursery and, if field collected, root-pruned at least a year before moving. A tree should be moved with a ball of earth large enough to protect as many roots as possible. After moving, thin the top to restore the normal root-shoot ratio. Back-fill the transplanting hole with a good grade of soil. Fertilize and water to help trees overcome transplant shock. Mulch the root zone to keep the soil cool and moist. Spray the trunk with lindane WP before wrapping. Be sure to use these insecticides in wettable powder forms since oils may injure the bark when trees are wrapped. Wrap the trunk with commercial borer wrap, burlap or even aluminum foil.

General Borer Control: Spray before young larvae hatch from eggs on the bark. Spray at monthly intervals through May, June and July. Direct the spray at the trunk and larger branches. Use 1 qt. of 20% lindane EC per 100 gal. of water. Another effective material is endosulfan (Thiodan) 50% WP at the rate of 2 lbs. per 100 gal. of water. Apply in early June and use enough to drench the bark.

Borers in the cambium beneath the bark may be cut out with a sharp knife. The exposed wood should then be treated with a good wound paint. Borers in the wood can sometimes be killed by cleaning out the tunnel with a piece of wire and injecting nicotine sulfate, malathion or carbon disulfide into the hole. Then seal the hole with mud, putty or caulking compound to confine the fumes.

LEAFMINERS

The larvae of leafminers feed by tunneling between the upper and lower leaf surfaces. These tunnels may be straight, twisted or blotch. Common leafminers are the holly leafminer, arbor vitae leafminer, boxwood leafminer, birch leafminer, locust leafminer, hawthorn leafminer and gregarious oak leafminer.

Control: Leafminer control depends upon applying insecticides at the right time. If the insecticide is not on foliage before the adults lay their eggs, the larvae already inside may not be killed. Make first applications early in May, and repeat at monthly intervals for species that have more than one generation per year.

Insecticides shown effective are 1 qt. of 20% lindane EC, or 1 lb. of 25% lindane WP per 100 gal. of water. Ethion, carbophenothion (Trithion), dimethoate (Cygon), malathion, phosphamidon, phorate (Thimet), and naled (Dibrom) also show promise. The systemic insecticides disulfoton (Di-Syston), and dimethoate (Cygon) have lasting effects when applied to the soil in mid-April.

GALLS

Insect galls are abnormal plant growths

induced by insect attack. They are produced by midges, wasps and aphids and vary in size and shape. Some mites produce the common hackberry witches broom and the maple bladder gall. Each insect species produces a typical gall formation. Oak and hickory trees are the favorite host for several hundred different gall insects.

Control: Presence of galls does not usually justify chemical control. And since gall tissue protects the insect inside, spraying after galls form is ineffective. When only a few galls occur, prune off and burn them.

Best control is to protect trees attacked in previous seasons. Apply preventive sprays early in the season. Dormant sprays of liquid lime sulfur, 11 gal. per 100 gal. of water, will prevent Cooley's spruce gall, the eastern spruce gall aphid, ash flower gall and the maple bladder gall. If lime sulfur will cause staining problems, apply a delayed dormant spray of 1 qt. of 57% malathion EC per 100 gal. of water just as buds are swelling. Similar sprays of malathion or lindane will prevent hickory pouch galls. To prevent hackberry nipple gall, vein pocket gall and marginal fold gall of pin oak, honey locust pod gall and gouty oak gall, apply one of the following when leaves are about 3/4 expanded: 1 to 2 lbs. of 50% carbaryl (Sevin) WP, or 1 to 2 qts. of 57% malathion EC, or 1 to 2 qts. of 20% lindane EC, or 2 lbs. 50% carbaryl (Sevin) WP per 100 gal. water. Also treat the soil beneath infested trees in early spring and in the fall with the above materials.

Monthly applications of demeton (Systox) will prevent the aerial and subterranean galls of wooly apple aphids on crab apples. Apply the sprays to the soil, trunk and foliage. For more information on gall insects, see Purdue Extension Publication E-56, Galls on Shade Trees and Ornamentals.

MITES

Mites are not insects, but tiny animals closely related to spiders and ticks. Sometimes called "spider mites", they spin silken threads over the host plant, causing speckling and webbing or bronzing of the foliage. Most mites can barely be seen with the naked eye. To be sure that mites are the cause of trouble, hold a sheet of white paper under a branch, and tap it sharply. Some mites will drop onto the paper and can be seen as tiny specks as they crawl about. Evergreens and deciduous trees are both subject to mite attack. Some mite species commonly associated with ornamental plants are the two-spotted mite or red spider mite, the spruce mite, the European red mite, the southern red mite, the honey locust mite and privet mite.

Control: Miticides when needed should be reapplied periodically throughout the summer. Miticides do not affect insects, but some insecticides, such as dimethoate (Cygon), malathion and parathion are effective against both mites and insects. Kelthane, morocide (Binadacryl) omite and pentac are all effective miticides. Tedion and ovex, primarily ovicides, are most effective when applied before mite populations become abundant. For complete information on mite control, see Purdue Extension Publication E-42, Mites on Ornamentals.

Alphabetical List of Trees and Shrubs and Their Important Insect Enemies

Insect	Remarks and control measures (amt insecticide/100 gal. a/)
	ALDER (Alnus)
Alder aphids (several species)	In heavy infestations, leaves curl and twigs grow twisted. (See Aphids, page 6)
Alder flea beetle	Bluish-green beetles and horned grubs skeletonize foliage in July and August. (See Leaf Beetles, page 9)
Alder leafminer	Blotch mines appear on the foliage in summer. (See Leafminers, page 10)
Alder lace bug	Upper surface of leaves become mottled with white splotches; lower surface spotted with brownish dots; numerous lacy-winged bugs clustered along mid-rib. (See Lacebugs, page 6)
	ALTHEA (See Rose of Sharon)
	APPLES, CRAB, FLOWERING (Malus)
Aphids (several species)	In heavy infestations, leaves curl and twigs grow twisted. Black sooty fungus grows in honey-dew making trees unsightly. (See Aphids, page 6)
Borers (several kinds)	Borers tunnel through heart and sapwood; injury indicated by dark, discolored, dead areas with sap and sawdust-like borings clinging to bark or littering ground. (See Borers, page 9)
Leaf-rollers	Leaves rolled or drawn together. (See Leaf-rollers, page 9)
Mites (several species)	Foliage is bronzed by small, yellow or brown specks caused by feeding mites. (See Mites, page 11)
Scale insects (several species like Putnam's, oystershell and San Jose)	Bark, twigs and small branches covered with small wax-covered insects. (See Scales, page 7)
Tent caterpillars	Hairy, brown caterpillars start feeding on foliage in mid-May. (See Leaf-feeding Caterpillars, page 8)
Tussock moth	In mid-May, black and white tufted caterpillars start feeding on foliage, particularly in urban areas. (See Leaf-feeding Caterpillars, page 8)

a/ For small quantities of spray, refer to the dilution table on page 37.

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	ARBOR VITAE (Thuja)
Leafminer	(See Junipers; many of the same pests.) (See Leafminers on page 10)
	ASH (Fraxinus)
Aphids (usually wooly)	(See Aphids, page 6)
Borers (several kinds)	(Use materials suggested for peach tree borers, page 26)
Fall webworm	Filmy webs containing many hairy caterpillars enclose ends of branches. (See Leaf-feeding Caterpillars, page 8)
Flower gall	Irregular clusters of distorted male flowers; conspicuous in winter. (See Galls, page 10)
Leafminer	In May, leaves first mined, then folded and skeletonized. (See Leafminers, page 10)
Scales (many kinds like oystershell, San Jose and scurfy)	(See Scales, page 7)
	AZALEA
Lacebugs	Upper surface of leaves mottled with white splotches; lower surface spotted with brownish dots and numerous lacy-winged bugs clustered along mid-rib. (See Lacebugs, page 6.)
Whitefly	Very small, white, four-winged insects cluster on leaves and flutter about when plant disturbed. (When noted, apply 1 qt. of endosulfan (Thiodan), 2 lbs. EC per gal., or 1 1/2 pts. Meta-Systox R SC, or 1 to 2 oz. per inch trunk diameter of Temik (aldicarb) 10% G, or 1 pt. of 40% nicotine sulfate plus soap. Parathion also highly effective, but only for use by commercial spray operators.)
	BARBERRY (Berberis)
Barberry aphid	Small yellowish aphids cluster on the stems and leaves. (See Aphids, page 6)
Barberry webworm	Leaves webbed together by a black caterpillar with white spots. (See Leaf-feeding Caterpillars, page 8)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	BASSWOOD (See Linden)
	BEECH (Fagus)
Aphids (usually wooly)	Bluish-white cottony masses on underside of leaves and small twigs. (See Aphids, page 6)
Scales (several species)	(See Scales, page 7)
Caterpillars (various species)	May be found feeding on beech foliage. (See Leaf-feeding Caterpillars, page 8)
	BIRCH (Betula)
Aphids (several species)	(See Aphids, page 6)
Bronze birch borer	The tops of trees begin to die one branch at a time due to insect tunneling in the sapwood. Entire tree usually dies in a few years. (See Borers, page 9)
Leafminer	In May and early June, small maggots tunnel in leaves causing them to turn brown. (See Leafminers, page 10)
Leaf skeletonizer	Tiny caterpillars feed on lower surface of leaves, causing them to turn brown. (See leaf feeding caterpillars page 8.)
Scale (usually brown race of oystershell)	Mahogany brown oystershell scales clustered on twigs and branches. Apply spray first of June and last week of July. (See Scales, page 7)
	BITTERSWEET (Celastrus)
Aphids (several species)	Soft bodied aphids appear on the new growth and leaves. (See Aphids, page 6)
Scale (several species, but usually euonymus)	Small, white scales appear on leaves and branches; oystershell-like female scales restricted primarily to branches. (See Scales, page 7)
Two-marked tree hopper	See Redbud.
	ORNAMENTAL BLUEBERRY (Vaccinium)
Black vine weevil	Rounded notches eaten out of leaf margins indicate presence. Primary damage by larvae eating roots and girdling larger ones. Black, shining adult weevils found under clods and debris near base of plant. Adults are easier to kill than the larvae. (In late June or early July, apply 1 pound actual chlordane. Spray lower

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	leaves and base of plant. Soil drenches helpful. For larval control, broadcast any of the above materials, and apply 10 pounds actual toxicant per acre, e.g., 200 pounds of 5% dust. Work into soil by cultivating and watering. One treatment of soil effective for years.)
Scale (usually Putnam's)	(See Scales, page 7)
	BOXELDER (Acer)
Boxelder bug	(See Maple; many of the same pests.) Bright red nymphs and large, black bugs with red lines on wings such juice from foliage and seeds. Adults harder to kill and require a heavier dosage of insecticide. Apply 1 qt. Sevin flowable or 1 qt. Diazinon (Spectracide) EC per 100 gal. of water. Apply enough to thoroughly wet the trees. (See Extension Publication E-24, "Boxelder Bugs".)
	BOXWOOD (Buxus)
Mites (at least two species)	Leaves become bronzed and speckled, and underside becomes webbed and covered with yellowish or reddish mites. (See Mites, page 11)
Leafminer	Small yellowish or greenish spots appear on lower leaf surface; later, a slight elevation and yellowish or brownish discoloration on upper surface. The lower surface shows blister-like area, and maggot or pupa may be seen through the thin tissue. Spray when the pupal heads have darkened. (See Leafminers, page 10)
Phyllid	Terminal leaves become cupped and contain small green insects covered with white waxy fibers. (In mid-May, apply lindane or malathion as described for Aphids, page 6)
	BUCKEYE (Aesculus)
	(See Horsechestnut)
	CATALPA
Catalpa worm	Large, green-marked caterpillars with prominent horn at rear of body defoliates trees. (see Leaf-feeding Caterpillars, page 8)
Mealybug	Large, cottony masses at base of trees and in forks of branches. (See Scales, page 7)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	CEDAR (See Juniper)
	CHERRY (Prunus)
Aphids (several species)	Black or greenish aphids suck sap from leaves and twigs. (See Aphids, page 6)
Borers (several species)	Insects burrow in trunks, branches and twigs. Presence indicated by masses of gum and brown sawdust like borings. (See Borers, page 9)
Leafhoppers	(See Leafhoppers, page 6)
Pear slug	Soft, slimy, dark-colored larvae skeletonize foliage. (See Sawflies and Slugs, page 9)
Scales (several species, usually San Jose and Putnam's)	Thin, grayish flaky-scales, with raised nipple-like areas in center, clustered on the bark. (See Scales, page 7)
	CLEMATIS
Bister beetles	Long, narrow, black beetles feed on flowers and foliage. (See Blister Beetles, page 8)
Clematis borer	Caterpillar bores in the fleshy root and overwinters as a larva in the root. Probing with small wire often kills larvae.
Nematodes	Tiny, thread-like worms may attack roots and kill the vine (See Purdue Extension Publication E-9).
Tarnished plant bug	Flattened, olive-green to brown bugs flecked with black and brown cause terminal and side branches to die-back. (See Plant Bugs, page 7)
	COTONEASTER
Lacebug	Foliage become spotted and discolored; underside of leaves spotted with black specks, and lacy-winged insects clustered near the mid-rib. (See Lacebugs, page 6)
Scales (San Jose and oystershell)	Bark, twigs and small branches covered with tiny insects. (See Scales, page 7)
Cotoneaster webworm	Leaves webbed together and skeletonized by small larvae. During dormant period, apply 11 gals. of liquid lime sulfur. (See Leaf-feeding Caterpillars, page 8)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	CRAB FLOWERING (Malus)
	(See Apple)
	CURRANT, FLOWERING (Ribes)
Aphids (several species)	Light green plant lice appear on twigs and leaves and weaken plant. (See Aphids, page 6)
Borers	Canes die because of larval tunneling. Prune out and burn as soon as discovered. (See borers, page 9)
Sawfly	Light green, black-spotted larvae feed on edge of leaves and defoliate plants. (See Sawfly, page 9.)
Scales (usually San Jose)	Small, circular scales with a nippled projection in the center encrust twigs. (See Scales, page 7)
	DOGWOOD (Cornus)
Borers (several species)	Trunk and twigs tunneled by legless grubs. (Use materials suggested for peach tree borer, page 26)
Leafhoppers	Small, yellowish, active, narrow-winged insects suck sap from leaves. Leaves appear light and stippled with white dots. (See Leafhoppers, page 6)
Scale (several; brown race of oystershell is common)	Small, wax-covered insects cluster on twigs and branches; most destructive on shrub forms. (See Scales, page 7)
	DUTCHMAN'S PIPE VINE (Aristolochior)
Caterpillars (several kinds)	Most common is brown with fleshy horns. Remove by hand where vines are not too large. (See Leaf-feeding Caterpillars, page 8)
	ELM (Ulmus)
Aphids (several species)	Light yellowish to green plant lice cluster on underside of leaves. Leaves often discolored by black fungus which grows in honey-dew. (See Aphids, page 6)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
Bark beetles (two species)	Small, dark brown beetles make shot holes in bark and tunnel beneath the bark into sapwood. Adults feed in twig crotches, cause twig casting and transmit spores of Dutch elm disease fungus. Remove and burn dead and dying elm trees. (During dormant period before mid-April, apply 12% methoxychlor with mist blower or 2% methoxychlor with a hydraulic sprayer.)
Caterpillars (several kinds)	Cankerworms, tussock moths and other caterpillars feed on foliage. (See Leaf-feeding Caterpillars, page 8)
Elm leaf beetle	Yellowish, black striped beetles and dull yellowish larvae with black stripes skeletonize leaves. (See Leaf Beetles, page 9). Apply materials suggested in early June and late July.
Leafhoppers (several kinds; Scaphoideus leteolus most troublesome)	White marked elm leafhopper nymphs, which are 3/8 inch long and banded with white, occur in the center of the crown and on the feathers of the trunk. This insect transmits phloem necrosis. (See Leafhoppers, page 6)
Scales (several species; scurfy and European elm scale most common)	Scurfy are white, pear-shaped scales; European elm scales are small, oval-shaped and brownish surrounded by a white fringe; Putnam scales are gray and circular. Crawlers present in mid-June. (See Scales, page 7)
	EUONYMUS
Aphids	Small, greenish, soft-bodied plant lice cluster on stems and leaves. (See Aphids, page 6)
Euonymus scale	Small, white, waxy scales cluster on leaves with larger, gray, oystershell-like females on twigs. (See Scales, page 7) Gardona has given excellent control of this species.
Winged euonymus scale Lepidosaphes yanagicola	Small, gray, oystershell-shaped scales on twigs between ridges of corky bark. During dormant period, apply DN compounds or 5% dormant oil. (During the last half of June, apply malathion, or parathion as described under Scale insects page 7.)
	FIR (Abies)
Bagworm	(See Bagworm, page 8)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
Balsam twig aphid	Small, greenish aphids covered with white, waxy fibers attack needles. (See Aphids, page 6)
Mites (several species)	Foliage spotted with yellow or brown spots; underneath side spotted with webbing. (See Mites, page 11)
Scales (several species)	Gray or white oystershell-shaped scales on needles. (See Scales, page 7)
	FORSYTHIA
Four-lined plant bug	Small, white areas on upper leaf surface caused by bright red bugs with black and yellow markings. Leaves may turn brown and drop and new growth wilt. (See Plant Bugs, page 7)
San Jose scale	Small circular scales with a nippled projection in the center. (See Scales, page 7)
	GRASS (See Purdue Extension Publication E-61, "Lawn Insects".)
	HACKBERRY (Celtis)
Lacebug	(See Lacebugs, page 6)
Galls (psyllid)	Nipple-shaped galls on leaves caused by tiny, cicada-like insects. (As soon as the leaves are 1/2 expanded, apply 2 lbs. of 50% carbaryl (Sevin), or 1 qt. of 57% malathion EC, or 1 1/2 qts. of 20% lindane EC, or 2 lbs. of 25% lindane WP, or 1 qt. of 25% Diazinon EC.)
Caterpillars	Usually larvae of mourning cloak butterfly--spiny, black caterpillars with red spots--feeding in groups. (See Leaf-feeding Caterpillars, page 8)
	HAWTHORN (Crataegus)
Aphids (several; some wooly)	(See Aphids, page 6)
Borers (several species)	(See Borers, page 9)
Caterpillars (several species)	(Whenever found in large numbers, apply materials discussed under Leaf-feeding Caterpillars, page 8)
Lacebugs	(See Lacebugs, page 6)
Leafhoppers	(See Leafhoppers, page 6)
Leafminers	(See Leafminers, page 10)
Mites	(See Mites, page 11)
Scales (mostly San Jose)	(See Scales, page 7)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	HAZELNUT (Corylus)
Aphids	Green plant lice on terminals and underside of leaves. (See Aphids, page 6)
Caterpillars (several species)	Some species attack foliage; some tie and roll leaves together. (See Leaf-feeding Caterpillars, page 8)
Bud galls	Terminal and lateral buds aborted, or galls caused by a tiny mite. Prune out and destroy infested branches. (See Galls, page 10)
Scales	Usually oystershell or the European fruit lecanium. (See Scale, page 7)
	HEMLOCK (Tsuga)
Black vine weevil	See Blueberry
Mites	Foliage off-color; individual needles spotted with yellow, fine silken webs on underside of needles. (See Mites, page 11)
Scales (usually oystershell)	Bark encrusted by small, twisted, wax-covered insects resembling small oystershells. (See Scales, page 7)
	HICKORY (Carya)
Aphids	(See Aphids, page 6)
Bark beetles	Small, legless larvae bore in sapwood under bark causing leaf fall and dead branches. (In July, when adults are present, apply materials suggested for Borers on page 9)
Caterpillars (many kinds)	Hickory foliage attacked. (See Leaf-feeding Caterpillars, page 8)
Galls (stem pouch gall)	Pouch-like galls on leaves, stems, twigs and branches; green at first, later turning black. (Just before bud break in spring, apply one of the materials suggested for Galls on page 10)
Twig girdler	Twigs and small branches girdled and fall to ground. Collect and destroy fallen twigs in fall or early spring.
	HOLLY (Ilex)
Leafminer	Twisted, yellowish to brown mines making foliage unsightly. (In mid-May, apply materials suggested for Leafminers, page 10. Be sure to add a miticide.)
Mites (southern red mites)	Foliage discolored by small grayish-green spots. Leaf size often reduced. (See Mites, page 11)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	HONEY LOCUST (Gleditsia)
Aphids, Leafhoppers and Plant Bugs	Trees fail to develop foliage until early summer. Apply Sevin as for Leafhoppers; see page 6.
Borer (Agrilus difficilis)	Wet, gummy spots around the nodes is one of the first symptoms. (See Borers, page 9.)
Caterpillars (especially the Mimosa webworm)	Foliage webbed together; leaflets skeletonized; entire tree appears scorched by fire. (Spray with carbaryl (Sevin) or toxaphene, and rake and destroy infested leaves. See Purdue Extension Publication E-11, "Mimosa Webworm.") Commercial growers may use Di-Syston and Ethion according to label directions.
Mites	Foliage off-color in late summer; individual infested leaflets drop from tree. Leaflets speckled with white spots, webbing and eggs clustered along veins. (See Mites, page 11.)
Pod gall	Leaflets distorted to form small pod on new growth. Infestations often require treatment to protect foliage. (Apply 1 qt. of 20% lindane EC in late May and again in late July.)
Scales (many kinds)	(See Scales, page 7.)
	HONEYSUCKLE (Lonicera)
Aphids (several species)	Plant lice congregate on shoots and leaves. (See Aphids, page 6.)
Leafroller	Leaves become rolled together, and larva feeds within the webbed leaves. (See Leafrollers, page 9.)
Sawflies	Grayish green, yellow and black spotted larvae defoliate bushes and vines. (See Sawflies, page 9.)
	HORSE CHESTNUT (Aesculus)
Bagworm	(See Bagworms, page 8.)
Scales (several kinds)	(See Scales, page 7.)
White-marked tussock moth	Hairy caterpillar with tufts of white and black hair and a red head eat foliage. (See Leaf-feeding Caterpillars, page 8.)
	HYDRANGEA
Aphids	Colonies of plant lice on shoots, leaves and in flower clusters. (See Aphids, page 6.)
Leaf-tyer	(See Leaf-tyers, page 9.)
Mites	(See Mites, page 11.)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
Tarnished plant bug	(See Plant bugs, page 7)
Rose chafer	Swarms of long-legged, tan beetles about 1/2 inch long feed on foliage, buds and fruit. Particularly serious in sandy areas. (As soon as adults are noticed, apply control measures suggested for Leaf Beetles, page 9)
	HYPERICUM
Scale (Aonidomytilis solidaginis)	Light tan scales resembling miniature oyster shells cluster under edges of peeling bark. (See Scales, page 7. Apply materials mentioned in mid-June.)
Mealybug (Trachycoccus hyperici)	White, flocculent masses of wax-cover, purplish insects under the edges of peeling bark. Insect difficult to control. (Commercial nurserymen will get best results with 1 pt. of 25% parathion EC in mid-June. Frequent application of phosphate insecticides suggested for Scale Insects on page 7. will also give control.)
	IVY (Parthenocissus)
Beetles (several species)	(See Leaf Beetles, page 9)
Eight-spotted forester	Brightly colored caterpillar, ringed with stripes of black, white and orange feeds on foliage. (See Leaf-feeding Caterpillars, page 8)
Leafhoppers (several species)	Numerous, small active insects suck sap from underside of leaves. Leaves stippled with white specks. (See Leafhoppers, page 6)
Scales (several species)	(See Scales, page 7)
	JAPANESE (FLOWERING) QUINCE (Chaenomeles)
Aphids	(See Aphids, page 6)
Scale (usually San Jose)	(See Scales, page 7)
	JUNIPERS (Juniperus)
Bagworm	(See Bagworm, page 8)
Bud midge (Oligotrophus sp.)	Buds yellow and hollowed out by feeding of small maggots. Heavy infestations prevent new growth. Control with 2 qts. of dimethoate (Cygon) (2 lbs. per gal. EC).

Insect	Remarks and control measures (amt. insecticide/100 gal.)
Mealybug	White, waxy masses concealing dark red mealybugs. (See Scales, page 7)
Russet mite (Trisetacus quadrisetus)	New growth distorted into clumps of tightly bunched needles, often twisted. Tiny mites feed in buds and prevent normal elongation. (Dormant application of liquid lime sulfur, 11 gallons, or summer application of sulfur dust very effective.)
Mites (several species but usually spruce mite)	(See Mites, page 11)
Scales (usually juniper or Taxus lecanium)	Juniper scales are very small, circular, grayish white scales with a yellow center on the needles. Lecanium scales are brown, hemispherical scales resembling small turtles along twigs and on needles. (See Scales, page 7)
Spittlebug	Frothy, saliva-like masses of spittle on stems and needles. Inside the masses are small, greenish-yellow, wingless nymphs that suck juices from the plant. (Apply 1 pt. of 20% lindane EC, or 1 qt. malathion 57% EC, as soon as spittle masses are found.) Professional spraymen may use 1 pt. of Dursban 2E per 100 gal. of water.
Webworm	Clumps of needles webbed tightly together by small, brown caterpillars which feed inside the webbings. (See Leaf-feeding Caterpillars, page 8. High pressure spraying essential.)
	LILAC (Syringa)
Lilac borer	Branches wilt or break off. Presence of borers indicated by accumulations of sawdust-like frass. (See Borers, page 9)
Scales (usually oystershell)	(See Scales, page 7)
Thrips	Foliage off-color and growth stunted; many small, pale yellowish insects lacerate foliage and suck up the exuding fluid. (Apply 1 lb. of 25% lindane WP, or 1 qt. of 20% lindane EC, or 1 qt. of 57% malathion EC, OR 1 qt. of 2E Cygon EC.)
	LINDEN (Tilia)
Aphids (several species)	(See Aphids, page 6)
Caterpillars (several kinds)	(See Leaf-feeding Caterpillars, page 8)
Leaf beetle	Yellow, oval beetles with green spotted wing covers and green stripe down the back eat ragged holes in leaves. Larvae creamy-white with yellowish heads. (See Leaf Beetles, page 9)
Scales	(See Scales, page 7)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	LOCUST, BLACK (Robinia)
Bagworm	(See Bagworm, page 8)
Borer	Sawdust-like accumulations usually evident in June and July. (In September, when the goldenrod starts to bloom, apply materials mentioned for Borers on page 9. to the tree trunks and any nearby patches of goldenrod.)
Leafminer	Blister-like spots or mines appear in leaves. (As soon as the leaves fully develop, apply materials mentioned for Leafminers, page 10)
Silver-spotted skipper	Leaves webbed together to form a nest. (Apply materials suggested for Leaf-feeding Caterpillars, page 8.)
Twig borer	Swollen twigs each containing larva in tunnel. Prune and burn. (See Borers, page 9)
	MAGNOLIA
Magnolia scale	Large, round, dark brown, hemispherical scales on twigs and branches. (See Scales, page 7)
	MAPLE (Acer)
Aphids (several species)	(See Aphids, page 6)
Bagworm	(See Bagworms, page 8)
Bladder gall	(See Galls, page 10)
Borers (several kinds)	(See Borers, page 9)
Caterpillars (several species)	(See Leaf-feeding Caterpillars, page 8)
Scales (several species; frequently cottonymaple or brown race of oyster-shell scale	(See Scales, page 7)
	MOUNTAIN ASH (Sorbus)
Borers	(See Borers, page 9)
Pear-leaf blister mite	Blister-like swellings on the lower surface of the leaves. (Apply materials recommended for dormant treatment of Galls on page 10)
Scales (particularly San Jose and scurfy)	(See Scales, page 7)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
	MULBERRY (Morus)
Mealybug	(See Scales, page 7)
Mites, red spider	(See Mites, page 11)
	NINEBARK (Physocarpus)
Aphids	(See Aphids, page 6)
	OAK (Quercus)
Borers	(See Borers, page 9)
Caterpillars (several species)	(See Leaf-feeding Caterpillars, page 8)
Galls (many kinds)	(See Galls, page 10)
June bugs or May beetle	Adults feed on foliage at night. (See Leaf Beetles, page 9)
Lacebug	(See Lacebugs, page 6)
Leafminers (gregarious oak and others)	Irregular patches and blotches in leaves caused by tunneling of larvae. (See Leafminers, page 10)
Leaf skeletonizer	See Birch.
Mites (several species)	(See Mites, page 11)
Periodical cicada	Twigs splintered by females laying eggs (See Purdue Extension Publication E-47, "The Periodical Cicada").
Scales (several species)	(See Scales, page 7)
Golden oak scale	A new pest to Indiana found particularly on pyramidal English Oaks. Small, yellowish-green, hemispherical scales on twigs and branches cause pits in the bark where they feed. Insect difficult to control. (Apply 1 qt. of 4 lbs. per gal. dimethoate (Cygon) EC when the crawlers hatch in the spring.)
Twig pruner	Small twigs cut off and hanging on tree or littering the ground. Collect and burn severed twigs.
	PACHYSANDRA
Scales (several species)	(See Scales, page 7)
	PEACH, FLOWERING (Prunus)
Japanese beetle	Active, metallic green beetles feed on foliage and fruit (See Purdue Extension Publication E-75, "The Japanese Beetle").

Insect	Remarks and control measures (amt. insecticide/100 gal.)
Oriental fruit moth	Growing terminals wilted and covered with resinous exudate. Caused by burrowing of small short-legged brown-headed worm. Immediately after bloom, start applying 2 lbs. of 50% carbaryl (Sevin) WP, or 1 1/4 lbs. of 25% Guthion WP, or 1 lb. Diazinon 50 W, or 2 lbs. of 15% parathion WP. Make applications through the summer at monthly intervals. Prune out and destroy wilted terminals.
Peach tree borers	Masses of exuding gum around base of tree and lower branches indicates one of several species present. In July, apply 1 1/2 qts. Thiodan 2 EC, or the materials suggested above for the oriental fruit moth. Repeat sprays at 3-week intervals. Thoroughly cover trunk, crotches and limb bases.
Scales (usually San Jose)	(See Scales, page 7.)
Tent caterpillars	(See Leaf-feeding Caterpillars, page 8.)
	PEAR, ORNAMENTAL (Pyrus)
Aphids	(See Aphids, page 6.)
Caterpillars	(See Leaf-feeding Caterpillars, page 8.)
Mites	(See Mites, page 11.)
Pear slug	Soft, slimy, dark larvae skeletonize the foliage. (See Sawflies and Slugs, page 9.)
Scales	(See Scales, page 7.)
Thrips	(See Lilac, page 23.)
	PECAN (See Hickory; many of the same pests)
	PERSIMMON (Diospyros)
Fall webworm	(See Leaf-feeding Caterpillars, page 8.)
San Jose scale	(See Scales, page 7.)
	PINE (Pinus -- ask for Publication E-32)
Aphids	Large brown or black plant lice cluster on growing terminals and needles; black fungus grows in the honey-dew. (See Aphids, page 6.)
Bagworm	(See Bagworms, page 8.)
Leafrollers	Terminals webbed together and tender bark eaten. (See Leafrollers, page 9.)
Mites or red spiders	(See Mites, page 11.)

Insect	Remarks and control measures (amt. insecticide/100 gal.)
Nantucket pine tip moth	Terminal buds and twig growth mined by small, tan larvae with black heads. During the summer, clip off and burn infested terminals. In early May and in late June, when adults are flying, apply 1 qt. Zectran 2E, or 1 1/4 lbs. of Dylox SP, or 3 pts Guthion liquid concentrate per 100 gal. of water. Soil applications of granular formulations of the systemic insecticide disulfoton (Di-Syston) has given two-season control. Use 2 1/2 oz. of 15% granule per inch of trunk diameter. Repeat application in 10 days.
Pine bark aphid	Trunk, underside of branches and terminals covered with white, cottony masses containing small aphids. Apply 1 lb. of 25% lindane WP.
Pine needle scale	Small whitish scales on needles. (See Scales, page 7.)
Sawflies (several species; European pine sawfly most important)	Striped or spotted, many-legged larvae feed in colonies, defoliate the plants. Spray with 1 qt. of malathion 57% EC, or 2 lbs. carbaryl (Sevimol 4), or Zectran 2E, 1 qt. per 100 gal. of water. For large acreages apply malathion ULV formulation using 13 fl. oz. per acre. Special nozzles are required for low volume applications. Special virus disease available for European pine sawfly control. Write Department of Entomology for information.
Spittlebug	See Junipers, page 22.
Shootmoth	Young larvae burrow in buds, preventing new growth and causing distorted, dwarf trees. Apply 3 pts. of Guthion LC, or 2 lbs. Guthion WP per 100 gal. of water. Repeat applications in 10 days. Applications of dimethoate (Cygon) 1 qt. EC per 100 gal. of water applied. Regardless of time applications are made coverage must be thorough.
Tube moth	On white pine, 5 to 20 needles webbed together with end of bunch eaten away Small greenish larva feeds inside needles. See Sawfly control.
Webworm	A brown, globular, sawdust-like nest on branches. Prune off and burn the nest.
Weevils, Pine (several species)	Small round holes nibbled on laterals; larvae tunnel beneath bark. Write Department of Entomology for special publication on control.
Zimmerman pine moth	Terminals wilt and brown in May and June; contain small pink larvae with black dots. Later in the season white, resinous masses in the whorl area mark larval activity beneath the bark. Entire top is often killed. In mid-August or mid-April, apply 1 qt. Zectran 2E, or 1 qt. Guthion EC, or 1 pt. Dibrom (naled), or 1 qt. Dylox LS per 100 gal. of water. All heavily-infested trees should be cut and burned. Ask for Purdue CES publication E-40.

PLUM (Prunus)

(See Cherry; pests similar -- page 16.)

Insects	Remarks and control measures (amt. insecticide/100 gal.)
	POPLAR (Populus)
Borers	(See Borers, page 9)
Fall webworm	(See Leaf-feeding Caterpillars, page 8)
Leaf beetle	Spotted, hard-shelled insects and grubs defoliate trees in mid-summer. (See Leaf Beetle, page 9)
Leafminers	(See Leafminers, page 10)
Mottled willow borer	Knotty galls on branches and limbs. (See Borers, page 9)
Sawfly	Black, yellow-spotted larvae defoliate trees in summer. (See Sawflies, page 9)
Scales (usually oystershell)	(See Scales, page 7)
	PRIVET (Ligustrum)
Leafroller	In early spring the growing tips webbed together by small larvae. (See Leafrollers, page 9)
Lilac borer	(See Borers, page 9)
Mealybug	(See Scales, page 7)
Privet mites	(See Mites, page 11)
Scale (usually oystershell)	(See Scales, page 7)
Thrips	Foliage off-color, growth stunted and many small, yellowish insects cluster on underside of leaves. As soon as Thrip injury is noticed, apply materials mentioned under Lilacs, page 23.
	PYRACANTHA
Lacebug	(See Lacebugs, page 6)
Scale (usually San Jose)	(See Scales, page 7)
	REDBUD (Cercis)
Caterpillars	(See Leaf-feeding Caterpillars, page 8)
Leafhoppers	(See Leafhoppers, page 6)
Mites	(See Mites, page 11)
Scale (usually lecanium)	(See Scale, page 7)
Two-marked treehopper	Insects with horn-like projections resembling a partridge. Jump rapidly when disturbed. White egg masses laid in August and September resemble scale insects. (If a problem, spray with 1 to 2 lbs. of 50% Sevin WP.

Insects	Remarks and control measures (amt. insecticide/100 gal.)
	RETINOSPORA
	(See Juniper; many of the same pests.)
	RHODODENDRON
Black vine weevil	See Blueberry.
Lacebug	(See Lacebugs, page 6)
Mites	(See Mites, page 11)
Rhododendron borer	Leaves and terminals wilt as a result of burrowing yellowish-white larva. Prune out and burn wilting terminals whenever noted. (See Borers, page 9)
Thrips	See Lilac, page 23.
Whitefly	See Azalea.
	ROSE (Rosa)
(Weekly applications of an all-purpose spray or dust gives satisfactory control of most pests attacking roses.)	
Aphids	(See Aphids, page 6)
Japanese beetle	Metallic green beetles eat flowers (See Purdue Extension Publication E-75, "The Japanese Beetle").
Leafroller	(See Leafrollers, page 9)
Red spider mite	(See Mites, page 11)
Rose chafer	See Hydrangea.
Rose slug	Soft sluggish worms leave a slimy glaze on and skeletonize foliage. (See Sawfly, page 9)
Scale	(See Scales, page 7)
Thrips	See Lilac. (Recent work indicates that 1 pint of 4 lbs. per gal. dimethoate (Cygon) EC is effective.)
	ROSE OF SHARON (Hibiscus)
Aphids	(See Aphids, page 6)
Corn earworm	Caterpillars feed in the flowers. (See Leaf-feeding caterpillars, page 8.)
Four-lined plant bug	See Forsythia.
San Jose scale	(See Scales, page 7)

Insects	Remarks and control measures (amt. insecticide/100 gal.)
	SASSAFRAS
Bagworm	(See Bagworm, page 8)
Scales	(See Scales, page 7)
	SERVICEBERRY, SHADBUSH (Amelanchier) (See Apple)
	SNOWBALL (See Viburnum)
	SPIREA
Aphids	(See Aphids, page 6)
Leafroller	(See Leafroller, page 9)
	SPRUCE (Picea)
Bagworm	(See Bagworm, page 8)
Galls (two species common)	Cooley spruce gall aphid produces pineapple-like galls on terminal growth of Colorado, Sitka and Englemann spruces. Eastern spruce gall aphid produces pineapple-shaped galls at the base of branches of Norway, red, white and black spruces. (See Galls, page 10)
Spruce bud scale	Apply malathion, Sevin, Diazinon or Ethion in mid-July
Spruce mite	Needles off-color, becoming yellowish, brown or russeted in appearance. Heavily-infested plants frequently show webbing. (See Mites, page 11)
Spruce needle miner and spruce epizeuxis	Dried mined needles and frass webbed together on terminals. (Apply malathion in early September.)
	SUMAC (Rhus)
Aphids	(See Aphids, page 6)
Leafhoppers	(See Leafhoppers, page 6)
Leafroller	(See Leafroller, page 9)
Scale	(See Scales, page 7)
	SWEET GUM (Liquidambar)
Bagworm	(See Bagworm, page 8)
Fall webworm and tent caterpillars	(See Leaf-feeding Caterpillars, page 8)
Scale (pit-making)	Circular, white scales with gray raised centers on twigs, branches and lower surfaces of leaves. Pimple-like disfigurations on the upper surface above each scale; area frequently discolored. (See Scales, page 7)

Insects	Remarks and control measures (amt. insecticide/100 gal.)
	SYCAMORE (Platanus)
Aphids	(See Aphids, page 6)
Bagworm	(See Bagworm, page 8)
Lacebugs	(See Lacebugs, page 6)
Tussock moths	Many tufted, hairy caterpillars feed on foliage in late summer. (See Leaf-feeding Caterpillars, page 8)
	TAXUS (See Yew)
	TREE OF HEAVEN (Ailanthus)
Ailanthus webworm	Small caterpillars live in web and devour foliage. Also cause leaves to wilt by feeding on the petioles. (See Leaf-feeding Caterpillars, page 8)
	TULIP TREE (Liriodendron)
Aphids	(See Aphids, page 6)
Borer, root collar	Bark just above soil line appears cracked and loose as if burned. Larval tunnels in soft phloem tissues. Walls of tunnel and adjacent wood may be stained black. (Paint or spray area with lindane. (See Borers, page 9.)
Caterpillars	Dark green larvae with large eye-spots on the thorax. (See Leaf-feeding Caterpillars, page 8)
Tulip tree scale	Large, yellowish-orange convex scales cluster on twigs and branches. (See Scales, page 7)
	TURF
	(See Purdue Extension Publication E-61, "Lawn Insects.")
	VIBURNUM
Aphids	(See Aphids, page 6)
Tarnished plant bug	(See Plant Bugs, page 7)
	VIRGINIA CREEPER (See Ivy)
	WALNUT (Juglans)
Aphids	(See Aphids, page 6)
Caterpillars (several kinds)	(See Leaf-feeding Caterpillars, page 8)
Scales (several kinds)	(See Scales, page 7)

Insects	Remarks and control measures (amt. insecticide/100 gal.)
	WILD CHERRY (Prunus)
Borers (usually lesser peach tree borer)	Presence indicated by masses of gum on trunk and branches. (See peach tree borers, page 25)
Eastern tent caterpillar	Tent of silk in branch crotches in spring. Larvae defoliate tree. (See Leaf-feeding Caterpillars, page 8)
	WILLOW (Salix)
Aphids (several species)	(See Aphids, page 6)
Borers (Several species)	(See Borers, page 9)
Fall webworm	(See Leaf-feeding Caterpillars, page 8)
Galls (several species)	Various shaped malformations on stems, twigs and leaves. Seldom of economic importance so no sprays necessary. Prune out and burn whenever found.
Leaf beetle	(See Leaf Beetles, page 9)
Sawflies	Black larvae with yellow spots on side of body defoliate trees. (See Sawflies, page 9)
Tent caterpillars	(See Leaf-feeding Caterpillars, page 8)
Scales (several kinds)	(See Scales, page 7)
	WISTERIA
Fall webworm	(See Leaf-feeding Caterpillars, page 8)
Mites	(See Mites, page 11)
Silver spotted skipper	Larva web leaves together to form a nest. (See Leaf-feeding Caterpillars, page 8)
	WITCH HAZEL (Hammelis)
Eastern tent caterpillars	(See Leaf-feeding Caterpillars, page 8)
	YEW (Taxus)
Black vine weevil	See Blueberry.
Taxus lecanium	(See Scales, page 7)
Taxus mealybug	Cottony masses on foliage and branches, particularly heavy on dense, sheared specimens. In mid-May, apply 4 lbs. of 25% malathion WP, or 1 qt. of 57% malathion EC. Parathion more effective, but must be used with extreme care.

Insects	Remarks and control measures (amt. insecticide/100 gal.)
Termites and carpenter ants	Trunks and larger branches hollowed out and nests constructed in the dead heartwood. Mud tunnels may be constructed at base of trunk and branches by termites. Carpenter ants build piles of sawdust. (Drench soil and base of plant with 1 gal. of 45% chlordane EC. Wash and cultivate deeply into the soil.

Spray Schedule for Insect Pests of Ornamentals

Hosts	Insect problem	Suggested materials*
DORMANT PERIOD (Usually from mid-November until last of March. The period between leaf fall the time buds begin to swell, or show green at the tips.)		
Most trees & shrubs	Scale insects, aphids and some mites.	Dormant oil, dinitro compounds, or lime sulfur
Elm	Bark beetles	Methoxychlor
Cotoneaster	Webworm	Lime sulfur
Junipers	Russet mite	Lime sulfur
DELAYED DORMANT (Early to middle April)		
Arbor vitae	Leafminer	Dimethoate (Cygon), lindane
Ash	Flower gall	Lime sulfur or malathion
Boxwood	Psyllid	Lindane
Honey locust	Pod gall	Lindane or carbaryl (Sevin)
Mountain ash	Pear leaf blister mite	Lime sulfur or malathion
Pine	European pine shoot moth Zimmerman pine moth	Guthion, dimethoate, Zectran, or Diazinon
Pin oak	Vein pocket and marginal fold galls	Lindane or carbaryl (Sevin)
Silver maple	Maple bladder gall	Lime sulfur or malathion
Spruce	Eastern spruce gall and Cooley's spruce gall	Lime sulfur or malathion

*Refer to previous sections for dilution rates.

Hosts	Insect problem	Suggested materials
EARLY MAY		
Many trees and shrubs	Caterpillars (several kinds)	Malathion or Dylox
Apple, honeysuckle, hydrangea, pine privet, spirea, etc.	Leafrollers	Guthion
Arbor vitae, hawthorn, birch,oak and holly	Leafminer	Lindane, or systemic insecticides
Azalea, rhododendron cotoneaster, sycamore, etc.	Lacebug	Lindane, or malathion
Birch	Bronze birch borer	Lindane
Boxwood	Psyllid	Lindane or malathion
Evergreens	Spruce mite	Kelthane, etc.
Hackberry	Galls	carbaryl (Sevin) or lindane
Hickory	Pouch gall	Malathion or lindane
Junipers	Webworm	Malathion, or Dibrom
Peach	Oriental fruit moth	Carbaryl (Sevin) or Guthion
Pines	Nantucket pine moth European pine sawfly	Malathion, Zectran, or specific virus for sawfly
Willow and poplar	Leaf beetles	Carbaryl (Sevin)
Yews	Mealybugs	Malathion, or parathion
EARLY JUNE		
Many evergreens and deciduous trees and shrubs	Bagworm	Malathion, toxaphene, Diazinon, or Dylox
Many trees and shrubs	Aphids and scales	Malathion
Chinese elm	Leaf beetle	Carbaryl (Sevin), Thiodan, or systemic insecticides
Dogwood (shrubs), redbud and lilac	Oystershell scale	Malathion
Euonymus	Euonymus scale	Malathion
Hypericum	Scale and mealybug	Malathion
Junipers	Juniper scale	Malathion

Hosts	Insect problem	Suggested materials
Oaks, particularly pyramidal English	Leafminer and golden oak scale	Dimethoate (Cygon)
Pine	Pine needle scale	Malathion
Sweetgum	Pit-making scale	Malathion
MID-JUNE		
Boxwood	Psyllids and leafminers	Malathion
Dogwood, elm, hawthorn, sumac, etc.	Leafhoppers	Carbaryl (Sevin), Malathion, Diazinon, or Meta-Systox^{R}
Elm	European elm tree scale and tussock moth	Malathion, or Carbaryl (Sevin)
Honeylocust	Mimosa webworm	Carbaryl (Sevin), Dylox, or Ethion
Pine	European pine shoot moth and Nantucket pine moth	Dimethoate (Cygon, DeFend), or Diazinon, or Zectran
Silver maple	Cottony maple scale	Malathion, or Carbaryl (Sevin)
Spruce	Bud scale	Malathion, or Carbaryl (Sevin)
Winged Euonymus	Scale, Lepidosaphes yanagicola	Malathion
Yew	Lecanium scale	Malathion
EARLY JULY		
Alder	Fleabeetle	Carbaryl (Sevin)
Hickory	Bark beetle	Lindane, or methoxychlor
Honeylocust	Mite	Kelthane, etc.
Oak	Oak kermes	Carbaryl (Sevin), or malathion
Peach	Peach tree borers	Thiodan, or Sevin, or Guthion
Privet	Thrips	Lindane
Yews, blueberries, etc.	Black vine weevil	Chlordane

Hosts	Insect problem	Suggested materials
LATE JULY		
Ash, birch, redbud, (shrubs) dogwood, silver maple, etc.	Brown race of oyster-shell scale	Malathion
Euonymus	Euonymus scale	Malathion
Honeylocust	Mimosa webworm and pod gall	Carbaryl (Sevin), or Dylox, or Ethion
Juniper	Juniper scale	Malathion
Pine	Pine needle scale	Malathion
Sycamore	Lacebug and tussock moth	Malathion, or carbaryl (Sevin)
MID-AUGUST		
Arbor vitae	Leafminer	Malathion, Lindane, Ethion
Birch and oak	Skeletonizer	Malathion, or lead arsenate
Boxelder	Boxelder bug	Sevin, or Diazinon
Chinese elm	Leaf beetle	Carbaryl (Sevin), or endosulfan (Thiodan)
Evergreens	Mites	Kelthane, etc.
Juniper	Bud midge	Dimethoate (Cygon), or Disulfoton (Di-Syston)
Pine	Zimmerman pine moth	Guthion, or Dibrom, or Zectran
Magnolia	Magnolia scale	Carbaryl (Sevin), or malathion
Oak, burr	Oak kermes	Carbaryl (Sevin), or malathion
Tulip tree	Tulip tree scale	Carbaryl (Sevin), or malathion
EARLY SEPTEMBER		
Black locust	Locust borer	Lindane
Spruce	Gall aphids	Malathion, or Lindane
MID-SEPTEMBER		
Euonymus	Euonymus scale	Malathion
Juniper	Webworm	Malathion, or Dibrom

DILUTION AND CONVERSION TABLE

It is often desirable to know the amounts of material needed for small quantities of spray when recommendations are based upon 100 gallons of spray solution. The figures given here are only approximations since the density of the different insecticides vary widely. The measurements given are for level measuring spoonsful. If directions for mixing small quantities of spray are given on the package, use them. If no directions are available for mixing small amounts, the following table will serve as a guide.

Liquid Measure

Amount per 100 gallons	Approximate dilution	Amount per gallon
1/4 pint (4 ounces)	1/3200	1/4 teaspoonful (1/24 ounce)
1 pint (1 pound)	1/800	1 teaspoonful (1/6 ounce)
1 quart (2 pounds)	1/400	2 teaspoonsful (1/3 ounce)
1 gallon (8 pounds)	1/100	2 1/2 tablespoonsful (1 1/3 ounces)
2 gallons (16 pounds)	1/50	5 tablespoonsful (2 2/3 ounces)
4 gallons (32 pounds)	1/25	1/2 pint (5 1/3 ounces)
11 gallons (88 pounds)	1/9	7/8 pint (14 2/3 ounces)

Dry Weight

1/2 pound (1/2 pint)	1/1600	1/12 ounce (1/2 teaspoonful)
1 pound (1 pint)	1/800	1/6 ounce (1 teaspoonful)
2 pounds (1 quart)	1/400	1/3 ounce (2 teaspoonsful)
3 pounds (1 1/2 quarts)	1/266	1/2 ounce (1 tablespoonful)
4 pounds (2 quarts)	1/200	2/3 ounce (1 1/3 tablespoonful)
5 pounds (2 1/2 quarts)	1/160	4/5 ounce (1 2/3 tablespoonful)
16 pounds (2 gallons)	1/50	2 3/5 ounces (5 1/3 tablespoonful)
20 pounds (2 1/4 gallons)	1/40	3 1/5 ounces (6 2/3 tablespoonsful)

1 teaspoon = 1/6 fluid ounce
1 tablespoon = 3 teaspoonsful = 1/2 ounce
2 tablespoonsful = 1 ounce
16 tablespoonsful = 1 cup

2 cups = 1 pint
1 pint = 1 pound = 96 teaspoonsful
8 pints = 1 gallon = 8 pounds

4/75

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